

HP 3852A Data Acquisition/Control Unit

HP 44725A 16-Channel General Purpose Switch Accessory

Configuration and Programming Manual



©Copyright Hewlett-Packard Company 1987,1988

Manual Part Number: 44725-90002
Microfiche Part Number 44725-99002

Printed: SEPTEMBER 1988
Printed in U.S.A. E0988

Printing History

New editions are complete revisions of the manual. Update packages, which are issued between editions, contain additional and replacement pages to be merged into the manual by the customer. The dates on the title page change only when a new edition or a new update is published. No information is incorporated into a reprinting unless it appears as a prior update; the edition does not change when an update is incorporated.

Many product updates and fixes do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

Edition 1 (Part Number 44725-90001).....	FEBRUARY 1987
Update 1 (Part Number 44725-90090).....	AUGUST 1987
Edition 2 (Part Number 44725-90002).....	SEPTEMBER 1988

RESTRICTED RIGHTS LEGEND

Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subdivision (b)(3)(ii) of the Rights in Technical Data and Computer Software clause at 52.227-7013.

Hewlett-Packard Company
3000 Hanover Street, Palo Alto, California 94304

Herstellerbescheinigung

Hiermit wird bescheinigt, daß das Gerät/System HP 3852A
in Übereinstimmung mit den Bestimmungen von Postverfügung 1046/84 funkentstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes/Systems angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Zusatzinformation für Meß- und Testgeräte

Werden Meß- und Testgeräte mit ungeschirmten Kabeln und/oder in offenen Meßaufbauten verwendet, so ist vom Betreiber sicherzustellen, daß die Funk-Entstörbestimmungen unter Betriebsbedingungen an seiner Grundstücksgrenze eingehalten werden.

Manufacturer's declaration

This is to certify that the equipment HP 3852A
is in accordance with the Radio Interference Requirements of Directive FTZ 1046/84. The German Bundespost was notified that this equipment was put into circulation, the right to check the series for compliance with the requirements was granted.

Additional Information for Test- and Measurement Equipment

If Test- and Measurement Equipment is operated with unscreened cables and/or used for measurements on open set-ups, the user has to assure that under operating conditions the Radio Interference Limits are still met at the border of his premises.

NOTICE

The information contained in this document is subject to change without notice.

HEWLETT-PACKARD MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Hewlett-Packard shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this material.

Hewlett-Packard assumes no responsibility for the use or reliability of its software on equipment that is not furnished by Hewlett-Packard.

This document contains proprietary information which is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced or translated to another language without the prior written consent of Hewlett-Packard Company.



**HEWLETT
PACKARD**

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard instrument product is warranted against defects in materials and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by -hp-. Buyer shall prepay shipping charges to -hp- and -hp- shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to -hp- from another country.

Duration and conditions of warranty for this instrument may be superceded when the instrument is integrated into (becomes a part of) other -hp- instrument products.

Hewlett-Packard warrants that its software and firmware designated by -hp- for use with an instrument will execute its programming instructions when properly installed on that instrument. Hewlett-Packard does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HEWLETT-PACKARD SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HEWLETT-PACKARD SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Under certain conditions, dangerous voltages may exist even with the instrument switched off. To avoid injuries, always disconnect input voltages and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.



Operating and Safety Symbols

Symbols Used On Products And In Manuals

~ LINE

AC line voltage input receptacle.



Instruction manual symbol affixed to product. Cautions the user to refer to respective instruction manual procedures to avoid possible damage to the product.



Indicates dangerous voltage – terminals connected to interior voltage exceeding 1000 volts.



OR



Protective conductor terminal. Indicates the field wiring terminal that must be connected to earth ground before operating equipment – protects against electrical shock in case of fault.



Clean ground (low-noise). Indicates terminal that must be connected to earth ground before operating equipment – for single common connections and protection against electrical shock in case of fault.



OR



Frame or chassis ground. Indicates equipment chassis ground terminal – normally connects to equipment frame and all metal parts.



Affixed to product containing static sensitive devices – use anti-static handling procedures to prevent electrostatic discharge damage to components.

NOTE

NOTE

Calls attention to a procedure, practice, or condition that requires special attention by the reader.

CAUTION

CAUTION

Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

WARNING

WARNING

Calls attention to a procedure, practice, or condition that could possibly cause bodily injury or death.

WARNING, CAUTION, and NOTE Symbols

Some labels on the HP 3852A, HP 3853A, and plug-in accessories include an international warning symbol (triangle with subscripted number) which refers the reader to the manuals for further information. This table shows the warning symbols used for the HP 3852A/3853A and plug-in accessories. Refer to the manual set for specific information on WARNINGS, CAUTIONS, or NOTES referenced with a warning symbol.

HP 3852A WARNING, CAUTION, and NOTE Symbols






Symbol	Meaning	Location
	Shock hazard originating outside the instrument (field wiring)	<ul style="list-style-type: none"> Analog Extender Connector on Power Supply Modules Terminal modules on plug-in accessories Component module covers on plug-in accessories
	Treat all channels as "one circuit" for safety purposes.	<ul style="list-style-type: none"> Inside terminal modules on plug-in accessories Metal cover on component modules of plug-in accessories
	Maximum number of certain plug-in accessories to be installed into an HP 3852A or HP 3853A.	<ul style="list-style-type: none"> HP 44701A, HP 44702A/B, HP 44727A/B/C plug-in accessories
	If High-Speed FET multiplexers are used with the HP 44702A/B, ribbon cable may be connected.	<ul style="list-style-type: none"> HP 44711A, 44712A, 44713A (referenced on HP 44702A and HP 44702B)
	The instrument should not be operated at a line frequency of 440 Hz with a line voltage of 200 V or greater as the AC leakage current may exceed 3.5 mA.	<ul style="list-style-type: none"> HP 3852A, HP 3853A Power Supply Modules

TABLE OF CONTENTS

Chapter 1 - INTRODUCTION

Manual Contents.....	1-1
GP Switch Description.....	1-1
Getting Started.....	1-2
Define Your Application.....	1-2
Configure the GP Switch.....	1-2
Program the GP Switch.....	1-2

Chapter 2 - CONFIGURING THE GP SWITCH

Chapter Contents.....	2-1
Connecting Field Wiring.....	2-1
Redundant Switching Control.....	2-3
Field Wiring Connections.....	2-4
Installation/Checkout.....	2-7

Chapter 3 - PROGRAMMING THE GP SWITCH

Introduction.....	3-1
Example Program Titles.....	3-1
Mainframe Firmware Revision.....	3-2
Programming Overview.....	3-3
Decimal Values vs. Bit Patterns.....	3-3
GP Switch Command Summary.....	3-5
Reading Channel States.....	3-6
Using CLOSE?.....	3-7
Using READ.....	3-7
Writing Channel States.....	3-8
Using OPEN and CLOSE.....	3-8
Using CHWRITE and CHWRITEM.....	3-9
Using WRITE and WRITEM.....	3-10

INDEX.....	I-1
------------	-----

Chapter 1

Introduction

Contents

Manual Contents.....	1-1
GP Switch Description.....	1-1
Getting Started.....	1-2
Define Your Application.....	1-2
Configure the GP Switch.....	1-2
Program the GP Switch.....	1-2

Chapter 1

Introduction

Manual Contents

This manual provides configuration and programming information for the HP 44725A 16-Channel General Purpose Switch (GP switch). For additional information on the accessory, refer to the HP 3852A Mainframe Configuration and Programming Manual. This manual contains three chapters:

- **Introduction** contains a manual overview, describes the GP switch, and shows a suggested getting started sequence.
- **Configuring the GP Switch** shows how to connect field wiring to the GP switch and how to install and check the accessory.
- **Programming the GP Switch** shows how to program the GP switch for two primary programming functions: reading channel states and writing to channels.

GP Switch Description

The HP 44725A 16-Channel General Purpose Switch (GP switch) provides 16 channels of moderate voltage level switching (up to 30 VDC or 42 VAC peak). Signals of up to 100 kHz can also be effectively switched because of excellent between-channel isolation.

All switches are low noise, break-before-make, SPDT Form C relays. Each switch (one for each channel) can be individually programmed, with accessory memory holding the switch in its programmed state until reprogrammed. At power-down, all switches return to the NORMALLY CLOSED (NC) position.

Getting Started

To use the GP switch for your application, you will need to:

- Define your application.
- Configure the GP switch.
- Program the GP switch.

Define Your Application

The first step is to determine the required configuration, current required for each output channel, and total current requirements. Refer to the Specifications appendix in the HP 3852A Mainframe Configuration and Programming Manual for current limitations per channel and for the accessory.

Configure the GP Switch

The next step is to configure the GP switch for your application. Since there are no jumpers or switches to set on the accessory, the only requirement is to connect the devices selected to desired channels on the GP switch terminal module. Refer to Chapter 2 - Configuring the GP Switch for example field wiring diagrams and procedures to check the GP switch ID.


Program the GP Switch

The third step is to program the GP switch channels to control the devices connected. Refer to Chapter 3 - Programming the GP Switch to program the accessory for two primary programming functions: reading channel states and writing to channels.

Chapter 2

Configuring The GP Switch

Contents

Chapter Contents.....	2-1
 Connecting Field Wiring.....	2-1
1, 2 Redundant Switching Control.....	2-3
Field Wiring Connections.....	2-4
Installation/Checkout.....	2-7

Chapter 2

Configuring the GP Switch

Chapter Contents

This chapter shows how to hardware configure the GP switch. It shows how to connect field wiring to the terminal module and how to check the GP switch identity. There are two steps to configure a GP switch:

- Connect field wiring.
- Install/checkout the GP switch.

When all required channels have been configured, refer to Chapter 3 - Programming the GP Switch to program the GP switch for your application.

Connecting Field Wiring

To begin configuring the GP switch, remove the terminal module cover. If the accessory is installed in the mainframe or an extender, refer to the HP 3852A Configuration and Programming Manual to remove the terminal module. Figure 2-1 shows the terminal module with the cover removed.

WARNING



***SHOCK HAZARD.** Only qualified, service-trained personnel who are aware of the hazards should install, remove, or configure any accessory. Before touching any installed accessory, turn off all power to the mainframe and extenders, to all installed accessories, and to all external devices connected to the mainframe, extenders, or accessories.*



WARNING

For safety, consider all accessory channels to be at the highest voltage applied to any channel.

CAUTION

Damage to accessory components can result from static discharge or excessive voltage. Use static-free handling methods and hold each module by its edges when installing, removing, or configuring the accessory.

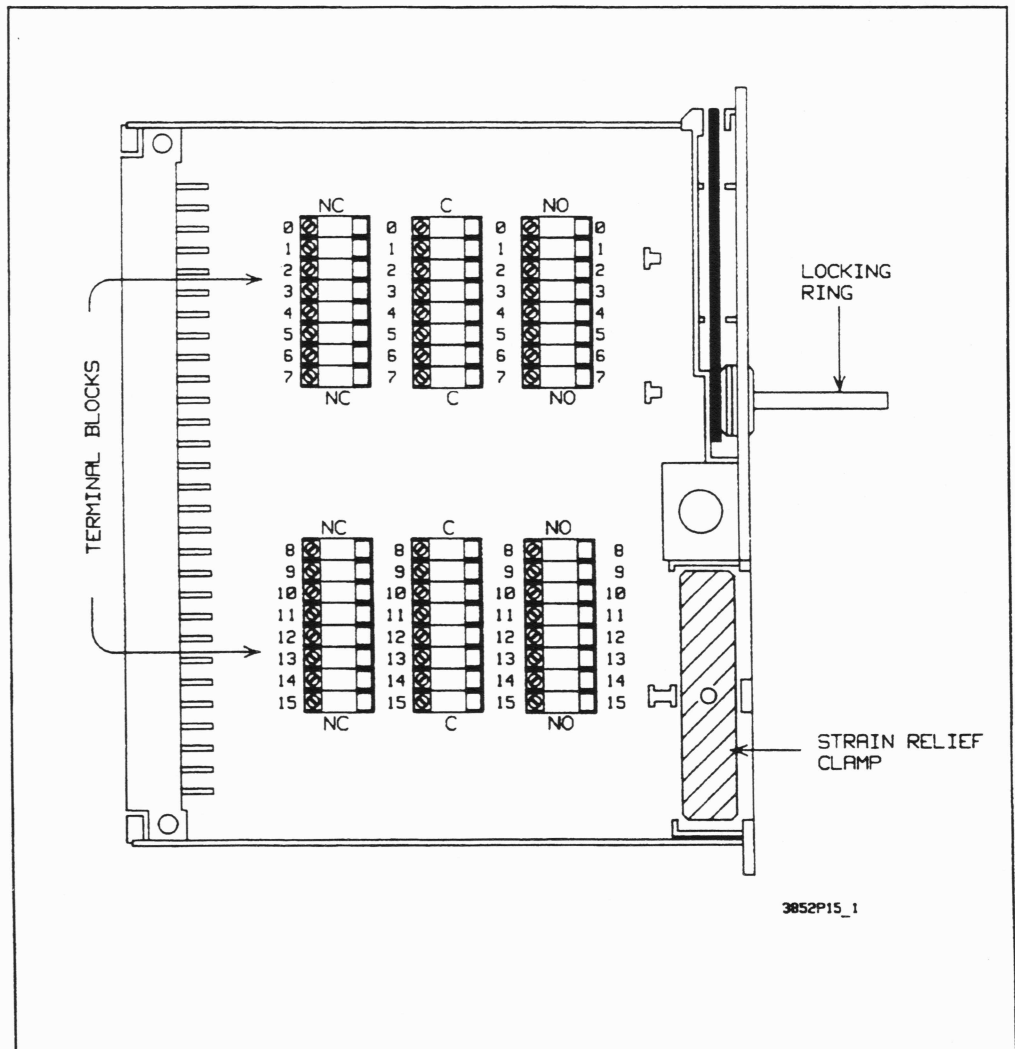


Figure 2-1. GP Switch Terminal Module

Redundant Switching Control

Before connecting field wiring to the GP switch, it is important to consider redundant switching control.



WARNING

GP switch failure during control of a critical process or function may cause danger to people or damage equipment. Always use redundant switching when configuring the GP switch to prevent danger to people or damage to equipment.

Figure 2-2 shows an example way to provide redundant switching control for the GP switch. The Redundancy Failure Indicator will light if the redundant control (Overtemp Control) relay NO contacts fuse together and the Overtemp Control relay deenergizes.

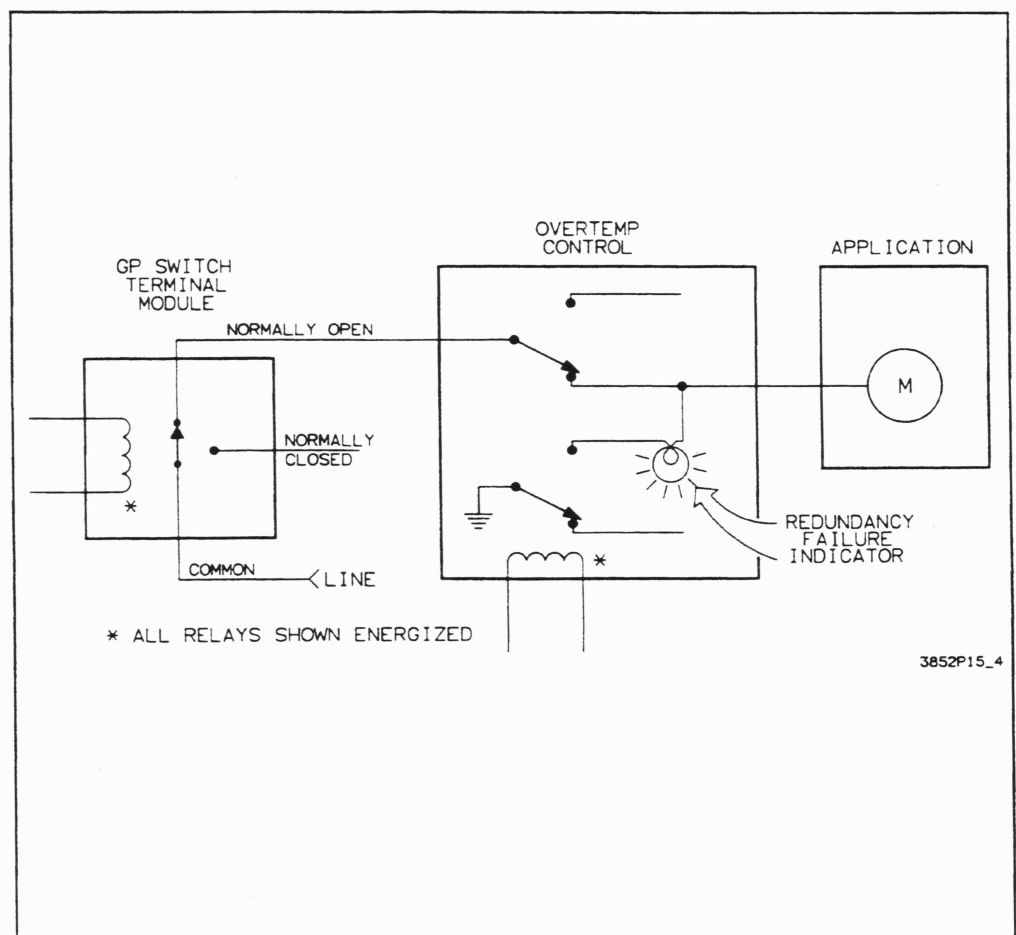


Figure 2-2. Redundant Switching Control Example

Field Wiring Connections

Configure the GP switch by connecting user field wiring to the NORMALLY OPEN (NO), COMMON (C), and NORMALLY CLOSED (NC) terminal blocks on the terminal module for required channels. Note that there are no jumpers or configuration switches on either the GP switch component module or on the terminal module which require setting.

Figure 2-3 shows simplified examples of field wiring connections for load switching, while Figure 2-4 shows some example connections for voltage and matrix switching. When connecting field wiring, place all field wiring leads under the module strain relief clamp. Tighten the clamp to ensure that all field wires are held firmly in place.

CAUTION

When switching inductive loads, provide external contact protection circuitry as required to limit the peak induction kick at switching to the maximum peak voltage specifications shown in the Specifications appendix of the HP 3852A Mainframe Configuration and Programming Manual.

NOTE

- 1. An RFI filter may be required for switching speeds greater than three-per-minute in order to comply with local conducted RFI limits (e.g., VDE 0875 in the Federal Republic of Germany).*
 - 2. Once gold (Au) plated silver-cadmium oxide (AgCdO) relay contacts have been used to switch moderate power (< 10 A) that supports arcing, the gold plating is vaporized and contact surfaces become AgCdO. The relay cannot then be used for signal switching, as AgCdO contact surfaces do not stay clean and may have increased resistance. The relay remains suitable for power switching, however.*
-

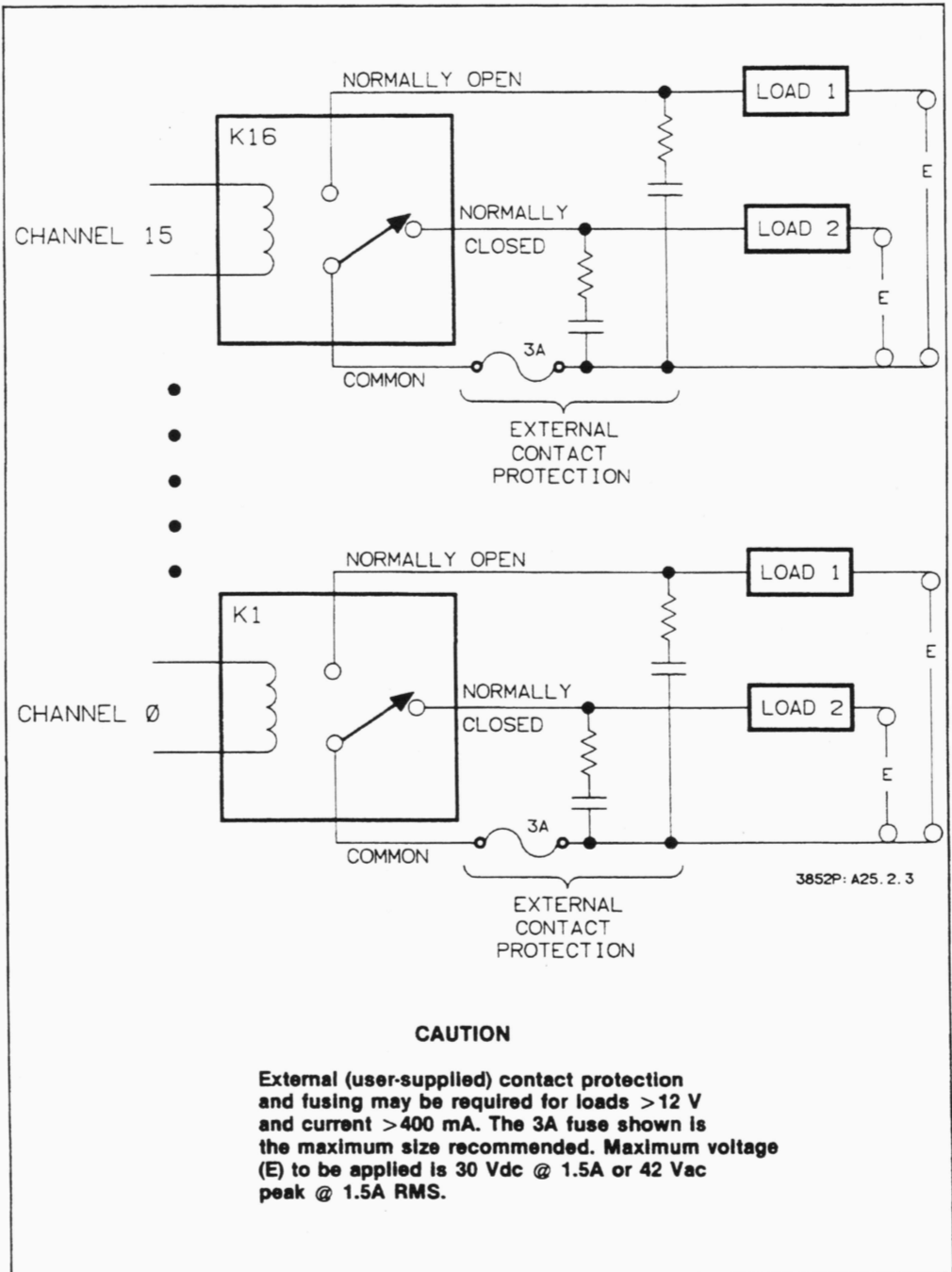


Figure 2-3. Load Switching Examples

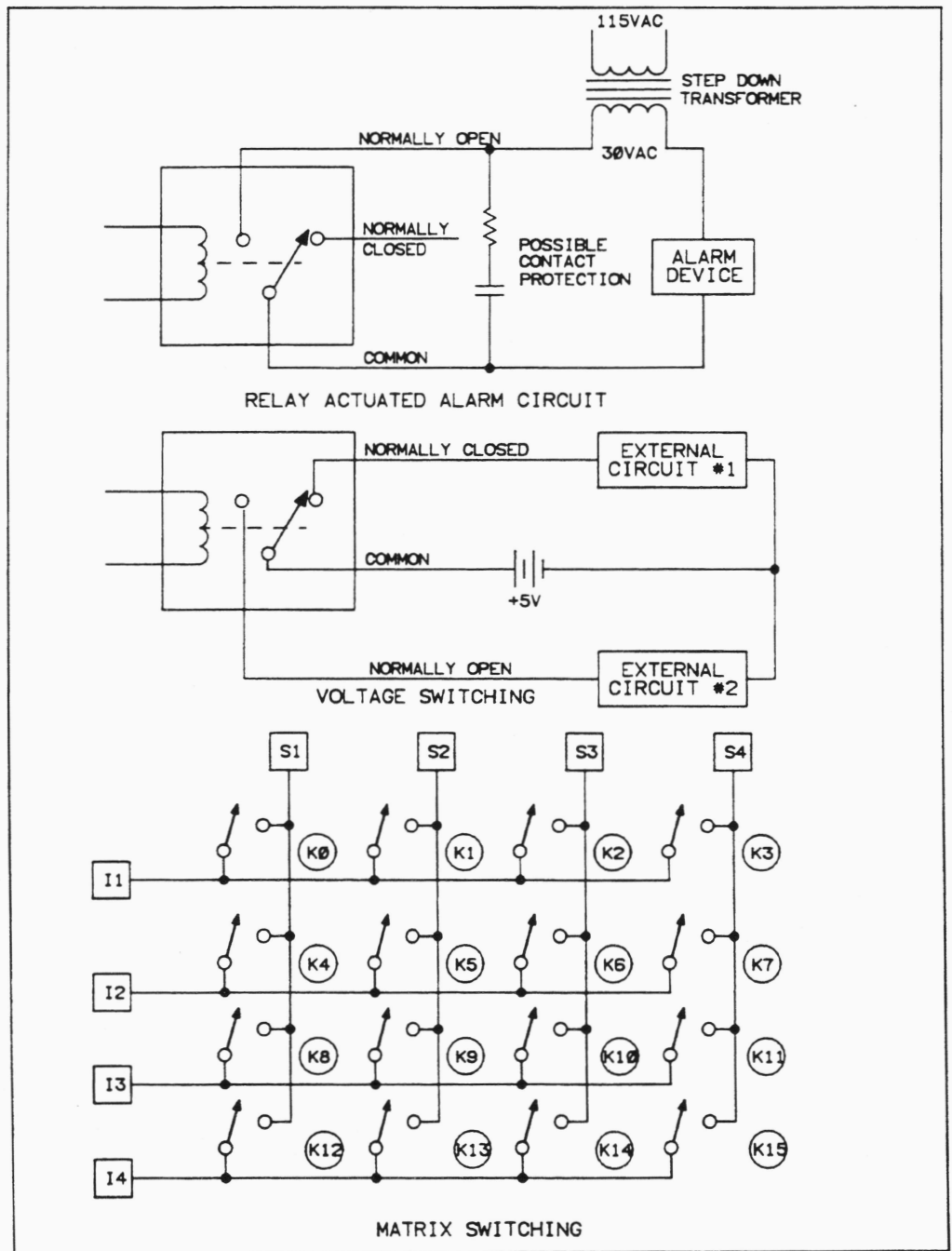


Figure 2-4. Voltage/Matrix Switching Examples

Installation/Checkout

When field wiring has been connected, connect the terminal module to the GP switch module and install the accessory in the desired slot. Refer to the HP 3852A Mainframe Configuration and Programming Manual to install the accessory.

When the accessory is installed, send the ID? command to check the accessory ID. At power-on, the GP switch returns 44725A, while a GP switch module only (no terminal module attached) returns 447XXX. (Note that if the terminal module is removed after power-on, the GP switch still returns 44725A.)

For example, the following program determines the identity of an accessory in slot 4 of the mainframe. A GP switch in this slot returns 44725A.

```
10 OUTPUT 709;"ID? 400"      !Query ID in mainframe slot 4
20 ENTER 709;A$              !Enter ID
30 PRINT A$                  !Display ID
40 END
```

If the GP switch does not return 44725A, be sure you have addressed the correct slot and the terminal module is installed. If these are correct but 44725A is not returned, refer to the HP 3852A Assembly Level Service Manual for service procedures.

This completes GP switch configuration. Refer to Chapter 3 - Programming the GP Switch to program the GP switch for your application.

Chapter 3

Programming The GP Switch

Contents

Introduction.....	3-1
Example Program Titles.....	3-1
Mainframe Firmware Revision.....	3-2
Programming Overview.....	3-3
Decimal Values vs. Bit Patterns.....	3-3
GP Switch Command Summary.....	3-5
Reading Channel States.....	3-6
Using CLOSE?.....	3-7
Using READ.....	3-7
Writing Channel States.....	3-8
Using OPEN and CLOSE.....	3-8
Using CHWRITE and CHWRITEM.....	3-9
Using WRITE and WRITEM.....	3-10

Chapter 3

Programming the GP Switch

Introduction

This chapter shows how to program the GP switch accessory. The chapter has four sections:

Introduction summarizes chapter contents, lists example program titles, and shows how to determine the mainframe firmware revision number.

Programming Overview gives an overview of binary-to-decimal conversion and provides an alphabetical summary of commands.

Reading Channel States shows how to read GP switch channel states using the READ and CLOSE? commands.

Writing Channel States shows how to write GP switch channel states using the OPEN, CLOSE, CHWRITE, CHWRITE, WRITE, and WRITEM commands.

NOTE

The example programs in this chapter use HP-IB address 709 and specific slot and channel numbers. Program syntax and data returns apply to HP 9000 Series 200/300 controllers. If you use a different controller, modify the syntax and data returns as required. Modify addresses as necessary for the slots and channels you use.

Example Program Titles

Discussion for each programming function includes example programs to show how to program the GP switch. Table 3-1 lists the titles of the example programs.

Table 3-1. Example Program Titles

Example	Description	Commands
Reading Channel States		
Read Channel States Using CLOSE?	Read state of individual channels in a slot using CLOSE?.	CLOSE?
Read Slot State Using READ	Read state of all channels in a slot using READ.	READ
Writing Channel States		
Write to Channels Using OPEN and CLOSE	Write data to open or close channels using the OPEN and CLOSE commands.	OPEN, CLOSE
Write to Channels Using CHWRITE	Write data to open or close a single channel using the CHWRITE command.	CHWRITE
Write to Channels Using CHWRITEM*	Write data to open or close several channels using the CHWRITEM command.	CHWRITEM
Write to Slot Using WRITE	Write data to open or close all channels on a slot using the WRITE command.	WRITE
Write to Slots Using WRITEM*	Write data to open or close all channels on two slots using the WRITEM command.	WRITEM

* = Program requires mainframe firmware revision 3.0 or greater.

Mainframe Firmware Revision

Since some commands for the GP switch require mainframe firmware revision 3.0 or greater (refer to the GP Switch Command Summary in Table 3-3), you may want to check the revision number for your mainframe to ensure that the accessory commands will be accepted. The following example program uses the IDN? command to check the mainframe ID, including the firmware revision number.

```

10 DIM Identity$(1:4)[17]           !Dimension controller array
20 OUTPUT 709;"IDN?"                !Query HP 3852A identity
30 ENTER 709;Identity$(*)           !Enter identity
40 PRINT USING "K,/";Identity$(*)   !Display identity
50 END

```

A typical return for firmware revision 3.0 follows.

```

HEWLETT PACKARD      (Company name)
3852A                 (Model number)
0                     (Mainframe serial number unknown)
3.0                   (Firmware revision 3.0)

```

Programming Overview

This section provides an overview of programming for the GP switch accessory. It includes a discussion of binary-to-decimal conversion and an alphabetical summary of commands for the GP switch.

Decimal Values vs. Bit Patterns

For HP 9000 Series 200/300 controllers, data inputs and returns must be in decimal format. For the GP switch, the *number* parameter in the WRITE *ch number* or the *data_list* parameter in the WRITEM *slot_list* DATA *data_list* command must be the decimal equivalent of the desired channel bit pattern. The range for the WRITE and WRITEM commands is -32768 to +32767 or 0 to 65535.

NOTE

Data returned to the controller by READ slot is the decimal equivalent of the channel bit pattern. The range of data returned by the READ command is -32768 to +32767 only.

This section shows how to compute decimal values for desired channel bit patterns and how to determine the bit pattern for a given decimal value. Table 3-2 shows the weighted decimal value for each channel number. For example, channel 0 has weighted decimal value 1, channel 5 has weighted decimal value 32, etc.

To compute the decimal value for a channel bit pattern, add the weighted decimal values of the "1" bits in the pattern, where "1" = channel closed (ON/NO) and "0" = channel open (OFF/NC). Examples follow to show how to compute the decimal value for a given bit pattern or to determine the bit pattern for a given decimal value.

Table 3-2. Decimal Values vs. Channel Numbers

Channel Number	Weighted Decimal Value	Channel Number	Weighted Decimal Value
0	1	8	256
1	2	9	512
2	4	10	1024
3	8	11	2048
4	16	12	4096
5	32	13	8192
6	64	14	16384
7	128	15	± 32768

Example: Finding Bit Pattern for Negative Decimal Value

To find the channel bit pattern for a negative decimal value (–32768 to –1), first determine the bit pattern for the positive decimal value. The 2's complement of this pattern is the bit pattern for the negative number. For example, the bit pattern for decimal –483 is computed as follows:

1. Decimal Value: –483 = ?
2. Bit Pattern for +483: 483 = 0000 0001 1110 0011
3. 2's Complement of +483: = 1111 1110 0001 1101
4. Bit Pattern for –483: –483 = 1111 1110 0001 1101

GP Switch Command Summary

Table 3-3 is an alphabetical summary of commands which apply to the GP switch. Refer to the HP 3852A Command Reference Manual for a complete description of these commands.

Table 3-3. GP Switch Command Summary

CHWRITE *ch_number*

Write state to the channel specified by *ch_number* = 0 sets the channel open (OFF/NC), while any non-zero integer between –32768 and +32767 sets the channel closed (ON/NO).

CHWRITEM *ch_list* **DATA** *state_list*

Write channel state(s) to open or close channels specified by *ch_list*. *state_list* = 0 opens the channels while any non-zero integer between –32768 and +32767 closes the channels. CHWRITEM uses one item from *DATA state_list* for each channel OR channel range in *ch_list*.

Up to ten channels or channel ranges can be specified along with up to ten channel states. If *ch_list* and *state_list* are stored in arrays, a larger number of channels and states can be specified. CHWRITEM requires firmware revision 3.0 or greater.

CLOSE *ch_list*

Sets channels specified by *ch_list* closed (ON/NO).

CLOSE? *ch_list* [**INTO** *name*] or [*fmt*]

Query state of channels of GP switch as specified by *ch_list*. Data returned for each channel in *ch_list*.

ID? *slot*

Reads identity of accessory in slot specified by *slot*. GP switch returns 44725A.

OPEN *ch_list*

Sets channels specified by *ch_list* open (OFF/NC).

Table 3-3. GP Switch Command Summary (Cont'd)

READ *slot [number] [INTO name] or [fmt]*

Read state of all GP switch channels in slot specified by *slot*. Returned data is decimal value of channel states with range = -32768 to +32767. *number* reads the slot the specified number of times. The *number* parameter requires firmware revision 3.0 or greater.

RST *slot*

Resets accessory in slot specified by *slot* to power-on state.

WRITE *slot number*

or

WRITE *slot data__list or array*

Write data to GP switch in slot specified by *slot*. *number* = decimal value of desired bit pattern, where 0 sets all channels open (OFF/NC), ..., -1 or 65535 sets all channels closed (ON/NO). LSB sets channel ES00 state, ..., MSB sets channel ES15 state. Range = -32768 to +32767 or 0 to 65535.

Specifying *data__list* or *array* writes successive numbers (bit patterns) to the GP switch. Up to ten bit patterns can be specified in a data list or the number of bit patterns can equal the size of a previously defined array. The range for numbers specified in the data list or stored in the array is -32768 to +32767. The *data__list* and *array* parameters require firmware revision 3.0 or greater.

WRITEM *slot__list DATA data__list*

Writes the state(s) to open and close specified channels in specified slots. *slot__list* is the address of the slots to which the desired bit patterns are written. *data__list* is the decimal equivalent(s) of the desired bit pattern(s).

Up to ten slot ranges or individual slots can be specified along with up to ten bit patterns. If the slot list and data list are stored in arrays, a larger number of slots and bit patterns can be specified. The range for the numbers is -32768 to +32767 or 0 to 65535. **WRITEM** requires firmware revision 3.0 or greater.

Reading Channel States

A main programming function for the GP switch is to read the state (open [OFF/NC] or closed [ON/NO]) of the channels. This section shows how to use the **CLOSE?** and **READ** commands to read channel states.

NOTE

*The **CLOSE?** and **READ** commands return the programmed state of the channels. If a hardware failure occurs, the programmed state returned may not reflect the actual state of the channel.*

Using CLOSE?

The CLOSE? *ch_list* [INTO *name*] or [*fmt*] command reads the programmed state of all channels specified by *ch_list*. Use CLOSE? to read the state of individual channels.

Example: Read Channel States Using CLOSE?

This program uses CLOSE? to read the programmed states of all channels of a GP switch in slot 2 of mainframe.

```
10  INTEGER A(0:15)           !Define array
20  OUTPUT 709;"CLOSE? 200-215" !Query channel states
30  ENTER 709;A(*)           !Enter channel states
40  PRINT A(*)               !Display channel states
50  END
```

For example, with channels 202, 205, and 213 closed (ON/NO), CLOSE? returns the following data, where 0 = channel OFF/NC and 1 = channel ON/NO. Since data is returned in the order requested, the first number is the channel 200 state and the last number is the channel 215 state.

```
0  0  1  0  0  1  0  0
0  0  0  0  0  1  0  0
```

Using READ

The READ *slot [number]* [INTO *name*] or [*fmt*] command reads the programmed state of all channels in the slot specified by *slot* the number of times specified by *number*. The [*number*] parameter requires mainframe firmware revision 3.0 or greater.

Example: Read Slot State Using READ

This program uses READ to determine the open/closed states of the 16 channels of a GP switch in slot 1 of the mainframe. Data is returned as the decimal equivalent of the channel bit pattern, where channel open (OFF/NC) = 0 and channel closed (ON/NO) = 1.

```
10  INTEGER B                 !Define controller variable
20  OUTPUT 709;"INTEGER A"    !Define mainframe variable
30  OUTPUT 709;"READ 100 INTO A" !Read slot 100 state, store in A
40  OUTPUT 709;"VREAD A"      !Transfer cont of A to out buffer
50  ENTER 709;B               !Enter slot 100 state
60  PRINT "Slot 100 State"     !Display header
70  PRINT B                   !Display slot 100 state
80  END
```

For example, if channels 100, 105, and 109 are closed (ON/NO), READ returns 545 which is the decimal value for channel bit pattern 0000 0010 0010 0001. A typical return is:

Slot 100 State
545

Writing Channel States

The second programming function for the GP switch is to write data to open or close channels. Use the OPEN, CLOSE, CHWRITE, and CHWRITEM commands to write data to channels or use the WRITE or WRITEM commands to write data to slots. Table 3-4 summarizes the functions of these commands. A discussion of each command follows.

Table 3-4. GP Switch Write Commands

Command	Function
OPEN <i>ch_list</i>	Open ch(s) specified by <i>ch_list</i> .
CLOSE <i>ch_list</i>	Close ch(s) specified by <i>ch_list</i> .
CHWRITE <i>ch number</i>	Open/close ch specified by <i>ch</i> .
CHWRITEM <i>ch_list</i> DATA <i>state_list</i> *	Open/close ch(s) specified by <i>ch_list</i> .
WRITE <i>slot number</i>	Open/close all chs in specified slot.
WRITEM <i>slot_list</i> DATA <i>data_list</i> *	Open/close all chs in specified slot(s).

* = Requires mainframe firmware revision 3.0 or greater.

NOTE

The RST slot (reset) command sets all channels in slot addressed to open (OFF/NC).

Using OPEN and CLOSE

The OPEN *ch_list* command sets all channels specified by *ch_list* open (OFF/NC), while the CLOSE *ch_list* command sets all channels specified by *ch_list* closed (ON/NO). The *ch_list* parameter can be a single channel, a list of channels, or a combination of channels and channel lists.

Example: Write to Channels Using OPEN and CLOSE

In this program, the CLOSE command closes channels 400 and 403 through 406 and the OPEN command opens the remaining channels of a GP switch in slot 4 of mainframe.

```

10  OUTPUT 709;"CLOSE 400,403-406"      !Close ch 400 and 403-406
20  OUTPUT 709;"OPEN 401,402,407-415"    !Open ch 401, 402, and 407-415
30  END

```

Using CHWRITE and CHWRITEM

The CHWRITE and CHWRITEM commands can also be used to write data to one or more channels in a slot. Use CHWRITE to write data to a single channel on a slot. For mainframe firmware revision 3.0 or greater, use CHWRITEM to write data to one or more channels on a slot.

The CHWRITE Command

CHWRITE *ch number* sets the channel specified by *ch* open (OFF/NC) or closed (ON/NO), depending on the value of *number*. For *number* = 0, the channel is open (OFF/NC). For non-zero integer values of *number* between -32768 and +32767, the channel is closed (ON/NO).

Example: Write to Channels Using CHWRITE

This program uses CHWRITE to open channel 405 and to close channel 413 of a GP switch in slot 4 of mainframe. Channels not addressed remain in their previous state.

```
10  OUTPUT 709;"CHWRITE 405,0"      !Open channel 405
20  OUTPUT 709;"CHWRITE 413,1"      !Close channel 413
30  END
```

The CHWRITEM Command

For mainframe firmware revision 3.0 or greater, CHWRITEM *ch_list* DATA *state_list* writes channel states (open or closed) to specific channels or channel ranges. A "0" for *state_list* opens the corresponding channel or range of channels. Any non-zero integer for *state_list* between -32768 and +32767 closes the associated channel or range of channels. Up to ten channels or channel ranges can be specified along with up to ten channel states. If the channel list and state list are stored in arrays, a larger number of channels and states can be specified.

Example: Write to Channels Using CHWRITEM

In this program, CHWRITEM closes channels 300 and 308 of a GP switch in slot 3 of the mainframe. When the command executes, the first "1" in the DATA *state_list* parameter closes channel 300 and the second "1" closes channel 308.

```
10  OUTPUT 709;"CHWRITEM 300,308 DATA 1,1"  !Close channels 300, 308
20  OUTPUT 709;"READ 300"                  !Read channel states
30  ENTER 709:A                             !Enter channel states
40  PRINT IVAL$(A,2)                        !Display channel pattern
50  END
```

By using the READ command and the HP 9000 Series 200/300 controller IVAL\$ function, channel closures can be verified. A typical return for this program follows, where the LSB = the channel 300 state and the MSB = the channel 315 state.

0000000100000001

Using WRITE and WRITEM

The WRITE and WRITEM commands can be used to write data to all channels in one or more slots. Use the WRITE command to write data to all channels in a single slot. For mainframe firmware revision 3.0 or greater, use the WRITEM command to write data to all channels in one or more slots.

The WRITE Command

WRITE *slot number* writes a decimal number specified by *number* to the slot specified by *slot*. The *number* range is -32768 to 32767 or 0 to 65535 and is the decimal value of the desired bit pattern for the channels, where channel bit 0 = channel open (OFF/NC) and channel bit 1 = channel closed (ON/NO). Refer to Table 3-2 for weighted decimal values for each channel.

For mainframe revision 3.0 or greater, the WRITE *slot data_list* or *array* command writes successive decimal numbers (bit patterns) specified by a data list or stored in an array. Up to ten bit patterns can be specified using a data list or the number of bit patterns can equal the size of the array. The range for the numbers specified or stored in the array is -32768 to +32767.

For example, WRITE 200,3,2,8,-1 writes state "3", followed by states "2", "8", and "-1" to slot 200. Or, if A has been defined as a 20-element mainframe array, WRITE 200,A(5) writes the state stored in element A(5) to slot 200.

Example: Write to Slot Using WRITE

This program uses the WRITE command to write state 97 (channels 200, 205, and 206 closed) to a GP switch in slot 200 of the mainframe. As a check, the READ command reads the state of the channels after WRITE is executed.

```

10  OUTPUT 709;"RST"           !Reset HP 3852A
20  OUTPUT 709;"WRITE 200,97"  !Write to channels
30  OUTPUT 709;"READ 200"      !Read slot 200 state
40  ENTER 709;A                !Enter slot 200 state
50  PRINT IVAL$(A,2)           !Display slot 200 state
60  END

```

Since the IVAL\$ function is used, a typical return for HP 9000 Series 200/300 (and equivalent) controllers follows, where the LSB = the channel 200 state and the MSB = the channel 215 state.

```
0000000001100001
```

The WRITEM Command

For mainframe firmware revision 3.0 or greater, WRITEM *slot__list* DATA *data__list* writes specified decimal numbers (bit patterns) to GP switch channel(s) in specified slot(s). Up to ten slot ranges or individual slots can be specified along with up to ten bit patterns. If the slot list and data list are stored in arrays, a larger number of slots and bit patterns can be specified. The range for *data__list* is -32768 to +32767 or 0 to 65535.

Example: Write to Slots Using WRITEM

In this program, WRITEM writes bit patterns to close channels 210, 211, and 215 of a GP switch in slot 2 of the mainframe and to close channels 301, 303, 304, 306, and 308 of a GP switch in slot 3 of the mainframe.

```

10  OUTPUT 709;"OUTBUF ON"      !Enable output buffering
20  OUTPUT 709;"WRITEM 200,300 DATA -29696,346" !Write bit patterns
30  OUTPUT 709;"READ 200"      !Read slot 200 states
40  OUTPUT 709;"READ 300"      !Read slot 300 states
50  FOR I=1 TO 2                !Start print loop
60      ENTER 709;A             !Enter ch states
70      PRINT IVAL$(A,2)        !Display ch states
80      PRINT                   !Space
90  NEXT I                      !Increment print loop
100 END

```

When WRITEM executes, the bit pattern represented by -29696 (1000 1100 0000 0000) is written to slot 200 and the bit pattern represented by 346 (0000 0001 0101 1010) is written to slot 300.

By using the READ command to verify the channel states and the HP 9000 Series 200/300 controller IVAL\$ function, the bit patterns can be displayed. A typical return follows, where the LSB = the channel ES00 state and the MSB = the channel ES15 state.

```
1000110000000000
0000000101011010
```


Contents

Index	I-1
-------------	-----

Index

B
Binary-to-decimal conversion,3-3

C
CHWRITE,3-9
CHWRITEM3-9
CLOSE,3-8
CLOSE?,3-7
Command summary,3-5
Configuration,2-1
Contact protection relay,2-5

D
Decimal-to-binary conversion,3-3
Description,1-1

E
Example program titles,3-1

F
Field wiring, connecting,2-1

G
Getting started,1-2

I
ID?,2-4
Installation/checkout,2-4

L
Load switching,2-5

M
Mainframe firmware revision,3-2

O
OPEN,3-8

P
Programming3-1

R
READ,3-7
Reading channel states,3-6
Redundant switching control,2-3
Relay contact protection,2-4
RFI filter requirements,2-4

S
Switching examples,2-5, 2-6

T
Terminal module,2-2

V
Voltage switching,2-6

W
WRITE,3-10
WRITEM,3-10
Writing channel states,3-8